SCIENCE

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FRIDAY, AUGUST 31, 1900.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson N. Y.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES.

REPORTS received from official sources show that during the past year the degree of doctor of philosophy has been conferred by 22 universities on 233 candidates. The numbers given by each university in the humanities and in the sciences and a comparison with the two preceding years are shown in the following table:

	Humanities.	Sciences.	Total for 1900.	1899.	1898.
Chicago.....	18	19	37	24	36
Harvard	21	15	36	24	26
Johns Hopkins..	13	20	33	38	33
Yale	16	10	26	30	34
Columbia	9	12	21	33	22
Cornell	8	11	19	7	19
Clark	0	9	9	5	12
Pennsylvania...	3	6	9	20	24
New York.....	7	0	7	9	5
Columbian	2	3	5	0	1
Michigan.....	4	1	5	4	7
Wisconsin.....	4	1	5	7	5
Brown	3	0	3	3	1
Minnesota	2	1	3	2	1
Princeton	2	1	3	3	0
Vanderbilt	2	1	3	0	0
California	1	1	2	3	1
Stanford.....	2	0	2	0	2
Virginia	2	0	2	2	0
Bryn Mawr	0	1	1	3	3
Nebraska	0	1	1	1	2
Tulane	1	0	1	0	0
Colorado	0	0	0	1	0
Kansas	0	0	0	1	0
Missouri	0	0	0	1	0
Syracuse	0	0	0	1	0
Washington...	0	0	0	2	0
Total.....	120	113	233	224	234

The table shows that the degree was conferred nine times more often than last year, but once less often than in 1898. For the three consecutive years beginning with 1898, the degree has been conferred in the sciences 105, 115 and 113 times; in the humanities 129, 109 and 120 times. Students are consequently pretty equally divided between the two divisions as here drawn. The separation is, of course, somewhat arbitrary. Psychology, sociology and education have been placed with the sciences, while philosophy and political economy are included under the humanities. Yet a student of philosophy may have interests falling strictly under the sciences—in the sense of the natural and exact sciences in which this word must for convenience be used—while a student of education may have but few such interests.

The degrees were in all cases the Ph.D., with the exception of one D.Sc. from Harvard. The University of Chicago conferred the degree of Ph.D. on nine students in the divinity school. These have not been included above as it is not certain that the work has been equivalent to that of the other candidates. The same holds, however, for some of the degrees in education and in chemistry in which cases perhaps a technical or professional degree should be given.

The University of Pennsylvania has during the year decided to require the printing of the doctors theses, and steps in this direction have been taken at Harvard. The degree seems not to have been given *causa honoris* by any important institution.

It appears from the tables and from the data on which they are based that the humanities are favored at Harvard and Yale and the sciences at Johns Hopkins, Columbia and Cornell. Last year Johns Hopkins gave more than its proportionate share of degrees in chemistry, physics, zoology and physiology, Chicago in mathematics, geology, sociology and education, Harvard in physics, zoology and anthropology, Columbia in astronomy, botany, zoology and education, Yale in paleontology and psychology, Cornell in botany and psychology and Clark in mathematics, psychology and education.

The distribution of students among the different sciences for 1900 and for the two preceding years is as follows:

	1900	1899	1898
Chemistry	26	32	27
Physics	15	7	11
Botany	12	11	11
Mathematics	11	13	11
Zoology	11	11	12
Psychology	9	15	18
Education	8	5	—
Geology	5	5	6
Astronomy	4	2	3
Physiology	4	1	4
Sociology	3	5	—
Anthropology	2	0	2
Paleontology	2	4	0
Bacteriology	1	1	0
Mineralogy	0	2	0
Meteorology	0	1	0
	113	115	105

The names of those on whom the doctorate was conferred for work in the sciences and the titles of their theses are as follows:

JOHNS HOPKINS UNIVERSITY.

Homer Van Valkenburg Black: The Permanganates of Barium, Strontium, and Calcium.

William Martin Blanchard: The Chlorides of Parabromorthosulphobenzoic Acid and some of their Derivatives.

Hall Canter: Orthophenylsulphonebenzoic Acid and related Compounds.

Charles Edward Caspari: An Investigation of the Fatty Oil contained in the seeds of *Lindera Benzoin*. II. Lauric Acid and some of its Derivatives.

Hardee Chambliss: The Permanganates of Magnesium, Zinc, and Cadmium.

James Edwin Duerden: West-Indian Madreporarian Polyps.

Luther Pfahler Eisenhart: Infinitesimal Deformation of Surfaces.

Wightman Wells Garner: Action of Aromatic Sulphonchlorides on Urea.

Lawrence Edmonds Griffin: The Anatomy of Nautilus Pompilius.

Joseph Cawdell Herrick: The Influence of Variation of Temperature upon Nervous Conductivity, studied by the Galvanometric Method.

David Wilbur Horn: A Study of the Action of Carbon Dioxide on the Borates of Barium, and of the Action of Acid Borates on Carbonate of Barium at High Temperatures.

William Bashford Huff: The Spectra of Mercury.

Robert Edmund Humphreys: The Action of Phenol on the Chlorides of Orthosulphobenzoic Acid.

Charles Ranald McInnes: Superosculated Sections of Surfaces.

Austin McDowell Patterson: The Reduction of Permanganic Acid by Hydrogen and Ethylene and a Study of some of its Salts.

Louis Maxwell Potts: Rowland's New Method for measuring Electric Absorption and Energy Losses due to Hysteresis and Foucault Currents, and Detection of Short Circuits in Coils.

Albert Moore Reese: Structure and Development of the Thyroid Gland in Petromyzon.

Herbert Meredith Reese: An Investigation of the Zeeman Effect with reference to Cadmium, Zinc, Magnesium, Iron, Nickel, Titanium, Carbon, Calcium, Aluminium, Silicon and Mercury.

Richard Burton Rowe: The Paleodevonian Formations in Maryland: a study of their Stratigraphy and Faunas.

Elisha Chisholm Walden: A Plethysmographic Study of the Conditions during Hypnotic Sleep.

THE UNIVERSITY OF CHICAGO.

John Charles Hessler: On Alkyl Malonic Nitrile Derivatives.

William McPherson: The Constitution of the Oxyazo Compounds.

Henry Chalmers Biddle: Ueber Derivate des Kuretins und der Formhydroxamsäure und ihre Beziehungen zur Knallsäure.

William Gillespie: Determination of all Hyperelliptic Integrals of the first kind of Genus 3 reducible to Elliptic Integrals by Transformations of the Second and Third Degrees.

Annie Marion MacLean: The Acadian Element in the Population of Nova Scotia.

Forest Ray Moulton: A Particular Class of Periodic Solutions of the Problem of Three Bodies.

Howell Emlyn Davies: The Occurrence of the Typhoid Bacillus in Typhoid Fever Patients.

Jacob Dorsey Forrest: The Development of Industrial Organizations.

Thomas Cramer Hopkins: The Genesis of Certain Limonite Ores of Pennsylvania.

Gilbert Ames Bliss: The Geodesic Lines on the Anchor Ring.

William Arthur Clark: Suggestion in Education.

Robert Francis Earhart: Sparking Distances between Plates for Small Distances.

Walter Eugene Garrey: The Effect of Ion upon the Aggregation of Infusoria.

Michael Frederic Guyer: The Spermatogenesis of Normal and Hybrid Pigeons.

Derrick Norman Lehmer: Asymptotic Evaluation of certain Totient-Sums.

William Newton Logan: A North American Epicontinental Sea of Jurassic Age.

John Hector McDonald: Concerning the System of the Binary Cubic and Quadratic with application to the Reduction of Hyperelliptic Integrals to Elliptic Integrals by a Transformation of Order Four.

Frank Lincoln Stevens: The Compound Oosphere of Albugo Bliti.

Ella Flagg Young: Isolation in School Systems.

HARVARD UNIVERSITY.

Harrison Hitchcock Brown: The Dialectic Constant of Water.

Roland Burrage Dixon: The Language of the Maidu Indians of California.

Waldermar Koch: Orthobenzochinone and some of its Derivatives.

Theodore Lyman: False Spectra from the Rowland Concave Grating.

William Edward McElfresh: The Influence of Occluded Hydrogen upon the Electrical Properties of certain Metals.

George Thomas Moore: A Contribution to the Knowledge of the Structure and Development of certain Unicellular Algae, with especial Reference to the Question of Polymorphism in the Chlorophyceae.

Harry George Parker: On the Occlusion of Baric Chloride by Baric Sulphate; A Revision of the Atomic Weight of Magnesium.

George Washington Pierce: Application of the Radio-Micrometer to the Measurement of Short Electric Waves.

Charles William Prentiss: The Otocyst of Decapod Crustacea: Its Structure, Development, and Physiology.

Herbert Wilbur Rand: A Study of the Regenerating Nervous System of Lumbricidae, with special regard to the Centrosome of Nerve Cells.

Charles Henry Rieber: Tactual Illusions: An Experimental Proof of the Spatial Harmony of Sight and Touch.

John Reed Swanton: The Morphology of the Chinook Verb.

Alvin Sawyer Wheeler: The Reduction Products of Dehydromucic Acid.

Stephen Riggs Williams: Changes Incident to the

Migration of the Eye in Pseudopleuronectes americanus, together with some Observations on the Optic Tract and Optic Tectum.

Amadeus William Grabau : Phylogeny of Gastropoda : I. The Fusidae and their Allies.

COLUMBIA UNIVERSITY.

George Neander Bauer : The Parallax of μ Cassiopeia and the Positions of 56 Neighboring Stars as deduced from the Rutherfurd Photographic Measures.

William Isaac Chamberlain : Education in India.

Caroline Ellen Furness : Catalogue of Stars within One Degree of the North Pole, and Optical Distortion of the Helsingfors Astrophotographic Telescope, deduced from Photographic Measures.

August Henry Gotthelf : The Action of Nitrils on Organic Acids.

David Griffith : The North American Lordariaceæ.

Tracy Elliot Hazen : The Ulothricaceæ and Chætophoraceæ of the United States.

Charles Judson Herrick : The Cranial and First Spinal Nerves of Menidia ; a Contribution on the Nerve Components of the Bony Fishes.

Aladine Cummings Longden : Electrical Resistance of Thin Films Deposited by Kathode Discharge.

Hermann Andreas Loos : A Study on the Constitution of Colophony Resin.

Frederick Clark Paulmier : The Spermatogenesis of Anasa Tristis.

Rudolph Rex Reeder : The Historical Development of School Readers and Method in Teaching Reading.

Frank Clarence Spencer : The Education of the Pueblo Child : a Study of Arrested Development.

CORNELL UNIVERSITY.

William Chandler Bagley : The Apperception of the Spoken Sentence.

Charles Edward Brewer : The Constitution of Galeïn and Coeruleïn.

Kary Cadmus Davis : A Taxonomic Study of North American Ranunculaceae as found in Gardens or Native.

Stevenson Whitcomb Fletcher: Pollination in Orchards.

Charles Tobias Knipp: The Surface Tension of Water above 100° Centigrade.

Gertude Shorb Martin: The Dying Out of Uncivilized Insular Peoples in Contact with Modern Civilization—a Study in Social Selection.

William Fairfield Mercer : The Development of the Wings of the Lepidoptera.

Wilhelm Miller : Chrysanthemums.

Edward Charles Murphy : The Windmill : Its Efficiency and the Conditions of its Economic Use.

William Alphonso Murrill : The Development of the Archegonium and Fertilization in the Hemlock Spruce.

Guy Montrose Whipple : An Analytic Study of the Judgment-Process in Discrimination of Clangs.

YALE UNIVERSITY.

Joseph Barrell : The Geology of the Elkhorn District, Montana.

Ernest William Brown : Contribution to the Chemistry of the Formation of Uric Acid in Man.

Alexander Cameron : Tactual Perception.

Herdman Fitzgerald Cleland : A Study of Fossil Faunas in the Hamilton Stage of New York.

Joseph Hall Hart : The Action of Light on Magnetism.

Herbert Edwin Hawkes : Examination and Extension of Peirce's Linear Associative Algebra.

Cloyd North McAllister : Researches on Writing.

William Kent Shepard : A new Solution for the Copper Voltameter.

William Valentine : Researches on Substitution ; The Action of Bromine on Metachlor-, Metabrom-, and Metaiodanilines ; The examination of Thiolbenzoic Acid in regard to its action on compounds containing Amido, Imido, and Hydroxyl Groups.

George Reber Wieland : Osteology of Some Fossil Turtles ; A Study of American Fossil Cycads : 1. Geological Distribution ; 2. Structure of the Leaf.

CLARK UNIVERSITY.

John S. French : On the Theory of the Pertingents to a Plane Curve.

Frank B. Williams : Geometry on Ruled Quartic Surfaces.

S. Elmer Slocum : On the Continuity of Groups Generated by Infinitesimal Transformations.

Halcott C. Moreno : On Ruled Loci in n-fold Space.

Thomas Rich Croswell : Amusements of Worcester School Children.

Norman Triplett : The Psychology of Conjuring Deceptions.

Frederick Eby : The Reconstruction of the Kindergarten.

Willard Stanton Small : Studies of the Psychology of the White Rat.

Charles Herbert Thurber : The Principles of School Organization.

UNIVERSITY OF PENNSYLVANIA.

Morton Githens Lloyd : The Transversal Thermomagnetic Effect in Bismuth.

Anna Jane McKeag : The Sensation of Pain : an Experimental and Critical Analysis.

George Ward Rockwell : An Electrolytic Study of Pyroracemic Acid.

Charles Lawrence Sargent: Alloys of Tungsten and of Molybdenum obtained in the Electric Furnace.

Charles Hugh Shaw: A Comparative Study of the flowers of *Polygala polygama* and *P. pauciflora*, with a Discussion of Cleistogamy.

Albert Duncan Yocum: An Inquiry into the Fundamental Processes of Addition and Subtraction.

COLUMBIAN UNIVERSITY.

Eugene Byrnes: Experiments on the direct Conversion of the Energy of Carbon into Electrical Energy.

Charles Russel Ely: Investigation of Phenomenon of Deliquescence and of the Capacity of Salts to attract Water Vapor.

Ernestine Fireman: The Action of Phosponium Iodide on Tetra and Penta Chlorides.

UNIVERSITY OF CALIFORNIA.

Walter Charles Blasdale: A Chemical Study of the Indument found on the Fronds of Gymnogramme triangularis.

BRYN MAWR COLLEGE.

Florence Peebles: Experiments in Regeneration and in Grafting of Hydrozoa.

UNIVERSITY OF MICHIGAN.

Eugene Cyrus Woodruff: The Effects of Temperature on the Tuning Fork.

UNIVERSITY OF MINNESOTA.

Bruce Fink: Contributions to a Knowledge of the Lichens of Minnesota.

UNIVERSITY OF NEBRASKA.

Charles Fordyce: The Cladocera of Nebraska.

PRINCETON UNIVERSITY.

Henry Norris Russell: The General Perturbations of the Major Areis of Eros caused by the Action of Mars; with the corresponding Terms in the Mean Longitude.

VANDERBILT UNIVERSITY.

J. Magruder Sullivan: Coal Tar Pitch and its High-boiling Fractions and Residue.

UNIVERSITY OF WISCONSIN.

Carl Edward Magnusson: The Anomalous Dispersion of Cyanin.

INERTIA AND GRAVITATION.

IT was shown by J. J. Thomson ('Effects produced by the Motion of Electrified Bodies,' *Phil. Mag.*, April, 1881), that a charged body has more inertia than an uncharged one.*

* The formula there given contains a slight slip in the numerical coefficient, as was first pointed out by Heaviside. $\frac{1}{3}$ should be written for $\frac{3}{15}$.

In 1890* and 1891† the writer introduced, for the first time, the conception that it was not only, as in the electrochemical theories of Davy, Berzelius, Helmholtz, and others, atoms in chemical combination or the dissociated components of a molecule, which had charges; but that all atoms, even in such substances as metallic copper and silver, possessed charges, and that the so-called neutral atoms were not devoid of charges, 'but had equal quantities of both kinds of electricity.'

For practically a year it was found impossible to secure publication of this theory, the two principal objections which the editors to whom it was sent made to it being that in the first place it was a fundamental fact that all electric charges must reside on the outside of conductors, and that consequently the atoms of a conductor, such as copper, could not possibly have individual charges, and secondly that 'the atoms, being self-evidently conductors themselves, or else the metal as a whole could not conduct,' the postulated equal charges on the atoms would immediately neutralize each other. A brief note was finally published by the kindness of the editor of the *Electrical World* in that paper,‡ but accompanied with an editorial to the effect that though the numerical relations connecting the elastic constants with atomic volume, discovered by the writer and adduced as proof of the theory, were no doubt interesting, the theory was probably wrong, and the efforts due 'to intermolecular forces just about sufficient to account for the particular sort of strain which we know as an electric charge.'

The above is not mentioned for the purpose of discrediting the judgment of the editors referred to, for when even specialists did not, at a much later date, see that it could be reconciled with the physical facts,

* Lecture, Elect. Soc., Newark, May, 1890.

† *Elec. World.*, Aug. 8 and Aug. 22, 1891.

there is, of course, much excuse for those who were not specialists in this particular line. But attention is called to it as illustrating the general trend of ideas at the time when the writer first attempted to introduce his theory.

Some time later, in Europe, similar ideas were put forward by other writers, notably by Richartz, Lorentz, Chattock, Larmor and others, and at the present time the theory may be considered to be on a strong footing.

The theory thus originated by me, that the ionic charge is always associated with the atom, in all conditions, naturally led to the conception that it might be the inertia effect of such a charge, acting in the way first shown by J. J. Thomson, which caused the inertia of matter. This idea was advanced by several writers, amongst others by Dr. Kennelly. But it was easily shown, and had in fact been ascertained previously by the writer, and no doubt by others, that, with the known dimensions of the atom, this hypothesis was untenable, the effect so produced being only about 10^{-8} of that necessary.

In subsequent papers,* the writer put forward the idea that "the atoms may be formed of vortex rings arranged in different kinds of space nets, with the direction of rotation of the vortex rings such as will make these combinations stable," and that "one might picture to one's self a vast portion of the 'atom dust' from which Mr. Spencer develops his universe, made of vortices and splitting up in these 67 ways to form the elements."

This hypothesis had for some time no real foundation. During the past year, however, the wonderful work of J. J. Thomson has resulted in almost certain proof of the fact that the atom is really made up of a large number of what he calls 'corpuscles,' each possessing an electric charge. In this paper (in the December number of the *Phil. Mag.*, 1899), Thomson recurred to the question of inertia being an electrical effect, but considered that there is at present no evidence to decide whether the corpuscles are small enough.

In 1891 the writer had shown that the atoms of a body in the solid state must be nearly touching each other, and that the phenomena which were supposed to militate most strongly against this supposition could be accounted for in a very simple manner. In a later paper* (read before the A. A. A. S., Columbus meeting, August, 1899), I showed that though the atoms were nearly touching each other, yet they really filled less than $\frac{1}{4}$ per cent. of the space which they occupied to the exclusion of other atoms.

From the two facts, *i. e.*, Thomson's discovery that the number of corpuscles in a hydrogen atom is of at least the order of one thousand, and the writer's discovery that the real volume of the atom is but a small portion of the space occupied by the atom, we arrive at the conclusion that the atom must be made up of a large number of corpuscles separated from each other by distances considerably larger than their diameters. This gives us data for making an approximate estimate as to the ability of the corpuscular charges to account for the inertia of the atom, and on making this calculation, we find, as the writer has shown,† that it really is the probable cause.

In other words, we may feel fairly confident that inertia is really not a separate and distinct thing, but merely a property due to the fact that the atom is made up of a very large number of electric charges.

I have recently found that gravitation can also be accounted for as a property

* Articles on Insulation, *Elect. World*, March, 1893, *et seq.*

* 'A Determination of the Nature of the Electric and Magnetic Quantities and of the Density and Elasticity of the Ether,' *Phys. Rev.*, January, 1900.

† 'Inertia.' *Elect. World*, 1900.

of these same corpuscular charges. It was first pointed out by Newton that if the density of the ether continually increased as we move away from a particle of matter, that we should obtain a gravitational effect. Later it was shown by other writers, notably by Kelvin, that the same result would follow if the density decreased. No way of accounting for this continuous variation of density has as yet been suggested. Again, it was shown by Maxwell that on any stressed medium theory of gravitation, the stresses must be enormous, whilst the estimates given by Kelvin of the elastic constants for the ether were not such apparently as to permit of this. But the writer showed, in the paper above referred to, that the elasticity of the ether is immensely great, *i. e.*, 6×10^{20}. Now if we calculate, as I have done in one of the papers referred to, what the diameter of the corpuscle must be, in order that it shall give the inertia effect, and from that calculate the electrostatic stress at the surface of a corpuscle, we find that it is of the order 10^{20}, and this stress acting on a medium whose elastic coefficients are as given, I have found, can produce a change of density sufficient to give the observed gravitational attraction.

We thus find that both inertia and gravitation are electrical effects and due to the fact that the atom consists of corpuscular charges. The constant ratio between quantity of inertia and quantity of gravitation, for a given body, is thus explained. We may state the theory thus:

The inertia of matter is due to the electromagnetic inductance of the corpuscular charges, and gravitation is due to the change of density of the ether surrounding the corpuscles, this change of density being a secondary effect arising from the electrostatic stresses of the corpuscular charges.

A fuller paper on this subject is in course of preparation, but will be delayed for some time by pressure of other work.

I may here mention that I have found that the equation

$$M/L^3 = M/LT^2 \times T^2/L^2,$$

given in the paper in the *Physical Review*, above referred to, and stated to represent a phenomenon not yet discovered, really represents Kerr's electrostatic optical effect, and the above gravitational effect, and that this effect therefore varies directly with the elastic coefficient of the dielectric. As this is one of the remaining links necessary to complete the full chain of proof of the theory there given, this latter is thus put upon a still firmer footing.*

The weight of matter in a gaseous state should be very slightly greater than in the solid state, and iron should weigh slightly less when dissolved. It is doubtful, however, whether the experimental conditions are not too difficult. If the measurement could be made it would give an independent method of arriving at the size of the corpuscle.

The writer has pointed out that the Kelvin-Maxwell theorem, deduced from the phenomenon of the electromagnetic rotation of light, that whenever we have a magnetic field we have also a rotation of the medium, is incorrect, in that it assumes that light consists of a certain kind of periodic motion for which there is no evidence. The question arises: In spite of the fact that the supposedly general theorem is incorrect, is there any actual material rotation concerned in the electromagnetic rotation of light? The answer I would give is 'yes, but not as a cause, merely as an effect.' According to the theory advanced by the writer,† the rotation is a consequence of light absorption, and can only take place in an absorbing medium. When the light waves strike the atoms, if the period of vi-

* A Determination of the Nature of the Electric and Magnetic Quantities. *Phys. Rev.*, January, 1900.

† *Ibid.*

bration of the corpuscular groups is very different from that of the waves, there is no absorption, and the light passes through unchanged. But at or near synchronism the group is set in vibration and causes the electric displacement to lag behind the voltivity. Hence, the group being set in vibration, and being in a magnetic field, it must, as was first pointed out by the writer,* and later by Lorentz, rotate. But this rotation is not a *cause* of the light rotation, but an effect.

Reginald A. Fessenden.

THE WORK OF THE SOCIETY FOR AGRICULTURAL EDUCATION.†

During the sixties in the Agricultural College, with which I have long been connected, one professor taught classes in agriculture, animal physiology, veterinary, breeds of live stock, stock feeding, farm crops, civil engineering, and was superintendent of the farm. In recent times this work has been placed in the hands of a dozen or more persons. I need not enumerate similar instances of the recent division of labor as exemplified in our universities. This is a day of specialists and the end is not yet.

The American Association for the Advancement of Science, which we shall attend here next week, when first organized had no sections, but the members all met together as long as the meetings continued. By degrees, as you all know, they increased till there are now nine sections, each with a full quota of officers, not to mention some sub-sections.

Recently, as though this was not enough, there have been formed a considerable number of distinct organizations, the programs of some of which contain much the same range of papers, presented mostly by the same members as those in the parent society.

Meetings during this week and next will be held here by fifteen affiliated societies.

In December, 1898, nine separate societies met during the same week at this university, and nearly every paper presented would have been received by some of the sections of the American Association.

The Fifth Congress of American Physicians and Surgeons was held at Washington, D. C., on May 1st, 2d and 3d. Fourteen distinct societies joined in the triennial Congress.

In much the same way journals occupying special fields of science have multiplied.

Previous to 1880, a number of American societies were organized for the discussion of agricultural topics and those of a kindred nature. For several reasons most of these survived only long enough to hold from one to three meetings.

In 1880, at Boston, a new plan was tried, viz, that of organizing the Society for the Promotion of Agricultural Science, consisting of twenty-one persons. It was the determination of its members to strive for papers of genuine worth and make no effort to draw crowded houses or to make a great display in any manner, whatever. The Society after continuing for twenty-one years has demonstrated beyond question that it is entitled to live and has important work to perform. In all, up to this time, there have been only one hundred and ten members. Those who have continued active, have been too conservative to suit a very few who were impatient for large numbers and more display. To most of us, it seemed of first importance to become acquainted with each other and learn the peculiarities of the members. Some men are restive and never remain active in any society for a very long time. Such may be expected to drop out and others will be elected to fill the places left vacant. Had

* *Elect. World*, May 18, 1895.

† President's Address at the Twentieth Meeting of the Society for the Promotion of Agricultural Science.

the membership been offered to all who sought it, there is little doubt that the Society would have scarcely survived long enough to hold ten annual meetings. As it is the membership has gradually increased and is larger than ever before, with other capable men ready to seek admittance. The Society was never so strong as it is to-day and the chances are that with wise management it will long continue to strengthen.

Every person who has long been an active member of any of the societies above mentioned, and many others, must be aware that a few persons in each need to continually exert themselves to prevent the death of the Society.

Probably there is no exception to the general rule that, a society like a business enterprise, before meeting with any marked degree of success must pass through some trials, metaphorically, must have the mumps, the chicken pox, measles, whooping cough, the grippe, after which, if it stand the strain well, it may be ready to engage in successful work.

In 1887, Congress began appropriating to each state and territory $15,000 a year for conducting experiments in agriculture. During the same period, the U. S. Department of Agriculture has rapidly extended its work, covering almost every conceivable field of agriculture and even some beyond its limits. The chiefs, and assistants and students are usually most capable and number all told over 600 persons.

The work performed by the Department is stupendous, covering a range of topics in a most creditable manner, and the value to the country is beyond estimate. To facilitate the work of experiment stations, including the agricultural colleges, and a small number from the department of agriculture, an annual conference of delegates is held once a year. Not only are the traveling expenses of these delegates paid, but the proceedings are printed and widely distributed by the government. Some have said, "Why isn't this an ideal plan, and why cannot these delegates from college and station perform all that it was intended should be done by the Society for the Promotion of Agricultural Science?" Here is the answer: (1) The presidents of the colleges and the directors of the stations are almost the only persons who attend these conferences oftener than once or twice in five years or more, and most of those who perform the experiments are never sent to the meetings. This scarcely gives any opportunity for the experimenters and professors of the colleges to maintain a continued interest in committee work and in other respects. For these reasons and others, a considerable number of them have become discouraged and advise standing by the Society for the Promotion of Agricultural Science. (2) Not two-thirds of our members are connected with any experiment station in the United States, and therefore, are ineligible as delegates to the meetings. (3) The time for holding the meetings of the station delegates comes at a season of the year when the teachers are busy in laboratory and class room. (4) Other reasons at this time need not be given.

It is not only a pleasant privilege, but a duty, even a necessity for teachers of various sciences and arts in agricultural courses to meet occasionally for acquaintance, each helping the other. Every year new subjects are developed and new and improved methods are discovered for demonstration. He who does not continually exert himself, will soon fall behind the race. No where is this more apparent than in agricultural colleges and experiment stations, for their work is of recent origin.

As athletics in these times interests nearly all students in a university, so the modern trend of agricultural education interests every one of our members. We are all in-

terested in aiming to shape good courses in agriculture, each championing his own department.

Almost any one in short order can place on paper groups of studies for each term of four years and call it a course of study, but to begin at the right end, experimenting and working out all the details of each topic, assigning reasons for each, before generalizing, classifying and grouping into courses requires much time, patience, skill and mature judgment. Nor can we ever expect to secure a uniformity in courses of study for different colleges. These must vary in different states to correspond to the demands of the people, the views of the faculty, and the special fitness of the members of the faculty for teaching certain topics. For twenty-five years I have been at work adjusting courses in agriculture to suit the views of myself and many new men as they entered the faculty from time to time. No two professors of agriculture or horticulture think alike. Besides great advances are all the time being made. There have come along one after the other or by twos and threes during thirty years, a host of new things, each clamoring for a place in the course, such as plant histology, parasitic fungi, the botanical study of grasses and other forage plants, the critical study of weeds from various stand points, forestry, the use of insecticides and fungicides, soil physics, stock feeding from the scientific side, growing beets and making sugar from them, making butter and cheese with scientific explanations for every step of the process, and smallest of all, though by no means of least importance, the little microbes as helps and hindrances to agriculture.

Some of our members are especially trained for the work of adjusting courses of study from time to time, to keep up to date, but to plan a course of study in agriculture which shall remain satisfactory and up with the times for more than a year or two at a time will be as disappointing as to attempt to deliver a course of lectures that shall not need remodelling in many particulars every year or two.

This is the way President Eliot put the question in his annual report for 1888–1889:

"A problem has been pressing upon every member of the board, old or young, experienced or unpracticed. During recent years every college teacher has been forced to answer anew the personal questions—What can I best teach, and how shall I teach it? Every man has really been obliged to take up new subjects and to treat them by new methods. There is not a single member of the faculty who is to-day teaching what he taught fifteen years ago as he then taught it. Each teacher has had to recast his own work, each department repeatedly to modify and extend its series of courses, and the faculty as a whole, to invent, readjust, and expand the comprehensive framework within which all these rapid changes and steady growth have taken place."

Notwithstanding all this, we must keep diligently studying to perfect even for the time, a schedule of studies, approaching nearer and nearer the ideal, though we never attain perfection.

University extension work has become a familiar phrase. Some professors and assistants in universities now devote all their time to the subject, while others devote a limited portion of time. The entire contents of magazines dwell on extension work.

In 1857, the first students entered the oldest agricultural college now in existence in this country. That was 43 years ago in April last. Such colleges had no pattern to follow, no men trained to the work; most of the farmers from the start were confident that such institutions would prove of no value; it was entirely against tradition. The colleges dwindled with a very short roll of students with no end of ridicule. What

was to be done? If the farmers would not send their sons to the colleges nor encourage their support, it was only a question of a few years when all such enterprises must be abandoned. Congress had made liberal endowments. If the farmers will not go to the colleges, then the colleges must go to the farmers. It was a matter of necessity. University extension is the taking of the university or college to the people, when the people cannot or will not go to the college or university.

According to H. B. Adams in the *Forum* for 1891, page 510, "The movement originated in the year 1867 in academic lectures to the school teachers and working men of the North England by Professor James Stuart of Cambridge, now member of Parliament."

A course was given in Great Britain by some of the professors in Cambridge University in 1873.

So far as I know the following account explains the origin of extension work in this country, at least its connection with agricultural colleges. On August 30, 1871, the trustees of the Illinois Industrial University, now known as the University of Illinois, passed a resolution that the regent and corresponding secretary be authorized to make such arrangements for holding, during the coming winter, Farmers' Institutes, at the University and in other parts of the State, as they might find advisable. Several institutes were held that year and others in succeeding years. The circular said, "We want to bring the live practical men and the live scientific men together that all may be benefited."

The regent of the University, Dr. J. M. Gregory, was the leading spirit in starting institutes in Illinois. Early in 1876, Michigan Agricultural College held her first institutes. Note that Illinois University began University extension two years before Cambridge in England. The rapid increase in the number and efficiency of institutes in most of the northern states is a subject familiar to all of you. A generation of objectors to good Agricultural Colleges has passed away and their places are occupied by those who are attentive and enthusiastic. Praise and support of the agricultural college has taken the place of apathy and criticism, and extension work has done it. More recently, beginning in 1888 to 1890, a considerable number of universities and colleges in this country have undertaken extension work in variety. Perhaps some of them saw the benefit that followed such efforts, made by the agricultural colleges. Itinerant instructors have been employed to work among manufacturers of butter and cheese in Canada and Wisconsin. In New York, special schools, enduring for a week, for giving instructions in horticulture, were held in many country school districts.

Extension reading courses are accomplishing something. Almost every plan conceivable has apparently been tried to arouse and attract men toward better methods in agriculture as aided by a scientific education. One of the most recent of these movements in agricultural education is the introduction of what is known as 'Nature Study' or 'Elementary Science' in the rural schools. We are most fortunate at this meeting in having with us an honored member who is brim full with experience and enthusiasm concerning this important subject. We are eager to listen to what he shall say. I am sure that I voice the opinion of every member of this Society when I say that we all favor a liberal education. None of us could dispense with mathematics, one or more languages and other substantial knowledge to be acquired in completing a course of study in any college in the land. Mathematics, Latin, rhetoric, history, physiology, English literature, political economy, ethics, chemistry, zoology,

botany and other branches of learning are placed in college courses, not necessarily because some of them give a better training than others, but because their study trains the person in different directions. A good course of study for the mind is comparable to a symmetrical training for the body, one develops many mental faculties, the other many of the muscles of the body. As the last echoes of the conflict between the champions of the classics and the natural sciences have not yet died away, will you permit me to refer briefly to the subject at this time? The opinions of educated men who lived eighty or ninety years ago are not to be taken in evidence in the matter, as there was no natural science in those days comparable to that of the present day. Nor can the opinions of philologists be taken without some degree of allowance, as their judgment is liable to be biased and one-sided, unless they have also had the benefit of a thorough training in botany and zoology for at least three years. They claim much for a study of Greek or Latin continued for four to five years, while they do not see great advantages in studying botany and zoology for one or two years. I will try to point out as fairly as I can some of the peculiar training afforded by three selected types of studies, viz, Mathematics, Latin and Botany.

(1) The utility of the study of mathematics is granted by every educated person. (2) There is no substitute for mathematics as a training in exact reasoning. (3) By this study a student learns to use concise language. (4) A clear statement is given, and step by step an inevitable conclusion is reached which is clear and accurate. (5) Here we find excellent examples of deductive reasoning.

The study of Latin (1) cultivates and strengthens the memory. (2) The faculty of attention or mental concentration is developed, that is, the successful student learns the significance of genuine study. (3) The perceptive faculties are well trained. (4) The study of Latin should lead to clear and concise speech and help to a better understanding of English. (5) Latin has an obvious etymological value, helping to understand the meaning of many English words. (6) It gives a training in the use of synonyms. (7) Latin cultivates the power of interpretation. (8) It exercises skill of a peculiar kind to observe all the shades of meaning of each Latin word in a long and intricate sentence and then translate it into clear and elegant English. (9) It requires the most discriminating use of the eye, mental alertness, the imagination, and the judgment. (10) There lies a thought clothed in Latin words; it is to be expressed in correct English. (11) The study enables one to get some of the best thoughts at first hand.

The advantages claimed for the study of botany are: (1) There is nothing better for training the powers of observation. (2) The comparison of one plant or one part of a plant with another cultivates the power of inductive reasoning. (3) In learning the definitions of new words, the memory is strengthened, the vocabulary enlarged. (4) There is nothing better to train the power of precise and brief description in using each word with a definite meaning. (5) To follow successive changes that take place in shape, proportion, size, color, as seen in one plant from seed to maturity, develops the observation, powers of description, and the judgment. (6) By experimenting to learn the results that follow changes in temperature, light, moisture; by mutilating or removing certain parts, many facts may be obtained enabling one to arrive at certain correct conclusions. (7) To become acquainted with the minute anatomy of plants by the aid of sections made in different directions and seen with a compound microscope cultivates the imagination as well as

the powers of observation and reasoning. (8) The preparation of materials for examination trains the hand to precision as well as the eye and the judgment. (9) "In studying botany a student gains in analytic and synthetic powers," T. C. Abott. (10) "It is the best system of practical logic, and the study exercises and shapes at once both the powers of reasoning and observation, more probably than any other pursuit," Asa Gray, who possessed a good knowledge of mathematics and Latin as well as of botany.

What shall I say of the value of training acquired by studying bacteria and lichens, by experimenting to demonstrate that certain fungi, like wheat rust and many others, assume two distinct forms on each of two different host plants? Here is need of extreme care to eliminate all sources of error. Facts are at length acquired (not given) and correct inevitable conclusions reached.

Take one step into the domain of horticulture. Selecting the parents and crossing one species or variety of plant with another, with the view of securing new and improved sorts, command the use of the eye, hand, imagination, keen judgment, and the experience of experts.

In selecting and matching apples suitable to exhibit at a fair, the eye, the sense of smell and taste and feeling, as well as the judgment are called into action.

Mathematics starts with definite indisputable facts to demonstrate a proposition.

Latin is based on usage and authority, not on proof. In botany the facts are first to be discovered and then a truth demonstrated. This is the process of reasoning in a large per cent. of all practical matters of life. Linguists claim that the student should devote four to five years to the study of Latin, while one or two years is considered ample time for botany. Let the student devote a year or two to Latin and four or five to botany and then make the comparisons.

You might naturally expect me to quote a few statements from Herbert Spencer. Here they are, old, but good:

"The education of most value for guidance, must at the same time be education of most value for discipline." "One advantage claimed for that devotion to language learning is that the memory is thereby strengthened. But the truth is, that the sciences afford far wider fields for the exercise of memory." "And when we pass to the organic sciences, the effect of memory becomes still greater." "While for the training of mere memory, science is as good as, if not better than language; it has an immense superiority in the kind of memory it cultivates. In language the facts are in a great measure incidental; in the acquirement of science, the connections of ideas correspond to facts that are mostly necessary. While the one exercises memory only, the other exercises both memory and understanding. A great superiority of science over languages as a means of discipline, is that it cultivates the judgment to a greater degree."

"The learning of language tends further to increase the already undue respect for authority. Quite opposite is the attitude of mind generated by the cultivation of science, which appeals to individual reason. Every step in a scientific investigation is submitted to the judgment. It exercises perseverance and sincerity." "In all its effects learning the meaning of things, is better than learning the meanings of words." I may have made a mistake in making this digression, but it is now all over.

I think the most thoroughly educated people are now agreed that the method of pursuing a study is of more importance than the selection of a subject. They believe that botany or zoology well taught, for the same length of time, affords as much discipline and culture as Latin, Greek or philosophy. But you may weary of this.

The programs of our meetings always announce some papers which have a scientific bearing on agriculture, forestry or some kindred line of business. As our members are specialists, it is fitting that we have each year a number of addresses of a general nature, such as summaries of progress, methods of experimenting, methods of teaching certain subjects, short syllabi of courses of study, and new points of general interest. These will be understood and will interest all, and will be likely to provoke a general discussion by the members.

The work of this Society during the past twenty years has apparently had a marked influence on the selection of subjects for discussion in some of the societies of this country. As an instance of the practical tendency of these subjects, if I may so express it, I cite you the admirable address of Vice-President Gage a year ago before Section F, of the A. A. A. S. at the Columbus meeting on 'The Importance and Promise in the Study of Domestic Animals.' Here are two sentences: "It is most earnestly believed, however, that in the whole range of zoology, no forms offer a greater reward for the study of the problems of life, especially in the higher groups, than the domestic animals. The importance of the study cannot be over-estimated from a purely scientific standpoint, and certainly if the prosperity, happiness and advancement of the human race are put in the count the subject is of transcendent importance."

Reference of a like nature might be made to numerous programs of scientific societies, to courses of study in colleges and univerties, to contributions to the best scientific journals of the day, but no argument on the subject is needed at this time, for the reason that no observing person can be found in this audience who does not already recognize the truth of the statement that I have last made.

I thank you for the high honor of choosing me president for a third time, and congratulate you on the excellent prospects for a successful meeting on this, its twentieth year, and predict that a long and useful career yet remains for the Society for the Promotion of Agricultural Science.

W. J. Beal.

Agricultural College, Mich.

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*THE BRITISH ASSOCIATION.**

For the second time, after a lapse of 27 years, the British Association will meet in Bradford in the beginning of September. Not a few of those who attended the first meeting are still alive, some of them being among the most distinguished of our living men of science. There is no doubt that a certain number of those who attended the previous meeting will again be present in Bradford next month. They will notice a very great change in the town; it has grown enormously; it has been to a large extent rebuilt; and it has been raised to the dignity of a city, while its population has probably doubled. Bradford will have much to show to those who are interested in the many practical applications of science. There will be abundant hospitality, receptions, dinners, a smoking concert, excursions to places of interest in the neighborhood, and other forms of entertainment for those—and they are many—who regard the annual British Association meeting as a gigantic picnic.

The meeting of 1873 was presided over by Professor A. W. Williamson, the distinguished chemist, whose presidential address consisted mainly of a review of the progress of chemistry up to that date. The advance in this, as in other directions, since then has been enormous. The president selected at the previous meeting had been the late distinguished physicist, Dr. Joule, but owing to the state of his health he had to forego the honor of presiding at the first Bradford

* A forecast from the London *Times*.

meeting and his place was taken by Professor Williamson. Among some of the well-know representatives of science who were present at the Bradford in 1873, and who are now no more, we may mention the names of Cayley, Clifford, H. J. S. Smith, W. Spottiswoode, Clerk-Maxwell, Balfour Stewart, W. B. Carpenter, John Phillips, Gwyn Jeffreys, Rutherford Alcock and Dr. Beke. The economic section was presided over by W. E. Forster, and it is of some interest to note that the present popular assistant general secretary, Mr. George Griffith, occupied the same position in 1873 that he does now, although for several years in the interval he ceased to be an officer of the Association. The first Bradford meeting had an attendance of close on two thousand, and the grants made for scientific research reached the considerable sum of £1685.

The second Bradford meeting will be presided over by Professor Sir William Turner, who for so long has filled with such distinction the anatomical chair of Edinburgh University. His address will consist of a general review of the progress of Biology, with special reference to our knowledge of the structure and function of cells. The program of work in the different sections leads one to expect that the proceedings will be of considerable scientific interest.

The president of Section A (Mathematical and Physical Science) will be Dr. Joseph Larmor, F.R.S. In opening the business of the section Dr. Larmor will review the change of ideas which has recently become current regarding the scope and method of physical explanation. The acceptance on the Continent, in consequence of the brilliant work of Hertz, of the views originated in England regarding the nature of electric actions and their dependence on the ether has been largely accompanied by an elimination of the dynamical explanations which formed a main feature of Clerk-Maxwell's theory. This makes it a matter of fundamental importance to determine, if possible, how far purely descriptive methods can avail without appeal to a dynamical foundation; it involves consideration of the mode of representation of the physical activities of the material atoms; and it raises the question whether denial of direct action at a distance necessarily implies transmission by simple stress such as occurs in a material elastic frame. As chairman for the department of Astronomy, Dr. A. A. Common will give an address on Friday morning. Monday will be devoted to Meteorology and Pure Mathematics, while a discussion on ions will be introduced by Professor Fitzgerald on Tuesday.

Section B (Chemistry) will be presided over by the distinguished chemist Professor H. W. Perkin. The subject of his address will be 'The Modern System of Teaching Practical Inorganic Chemistry, and its Development'; and, after discussing the progress which has been made in the teaching of practical chemistry in schools, he will point out that during the last thirty years very little similar progress has been made in teaching inorganic chemistry in universities and colleges. Having shown that the system adopted at the present day is practically the same as that taught thirty years ago, Professor Perkin will next proceed to give a historical sketch of the development of this system, and will conclude his address with a discussion of the question whether the present system is the best and most suitable for teaching practical inorganic chemistry, or whether it might not with advantage be considerably modified. The greater part of the time of the Section will be devoted to discussions on (1) the chemistry of camphor, to be opened by Dr. Lapworth; (2) the questions raised by recent work on metals and alloys, to be opened by Mr. W. H. Neville, F.R.S., of Cambridge, in the course of which it is

to be hoped that the important question "What is a metal?" may be settled; (3) the recent developments in connection with asymmetric structure in carbon and other compounds, to be opened by Mr. W. J. Pope, of the Central Technical College; and (4) the recent improvements in the textile industries (including artificial silk, etc.), to be opened by Dr. Liebmann. Among other papers promised are: 'Some Recent Work on the Diffusion of Gases and Liquids,' by Mr. Horace T. Brown; 'Determination of the Spectra of Gases at 400° C.,' by Professor Dixon; and 'On the Relationship between the Heating and Lighting Power of Coal Gas,' by Mr. T. Fairley. A paper of great local interest will be one on the treatment of woolcombers' effluents, by Mr. W. Teach; while the relations of phosphorus, iron, and carbon when present in iron and steel will be discussed by Mr. J. E. Stead, of Middlesbrough. Papers have also been promised by Professor Smithells, Dr. Laurence, Dr. J. B. Cohen, and Mr. F. W. Richardson. Professor Ewing and Mr. Rosenhaim will show slides illustrating the effects of strain and annealing on the crystalline structure of metals.

The Geological Section (C) will have as its president one of the most unconventional and brilliant of the younger geologists—Professor W. J. Sollas. The subject of his address will be 'Evolutional Geology.' The transformation of the science during the latter part of the 19th century, by which its scattered teachings have been organized into a compact body of doctrine and the whole science placed on a more philosophic basis, will be briefly alluded to. An account will be given of the development of the earth, including its early evolutional stages, which were once considered alien to geology. Its distribution in time will be particularly considered, and the dates of various critical periods in its history will be discussed.

As befits the *locale* of the meeting, the Section will devote especial attention to the carboniferous rocks, and particularly to the coal measures. One of the important events of the meeting will be a joint discussion with the Botanical Section (K) on the conditions which existed during the growth of the forest which supplied the material for coal. This is set down for Monday, September 10th, and the discussion will be opened on behalf of the geologists by Mr. A. Strahan, of her Majesty's Geological Survey (who for some time past has been engaged in supervising the mapping of the coal fields of South Wales), and Mr. J. E. Marr, F.R.S., a past-president of the section. It is expected that several other prominent geologists who have devoted attention to the coal measures will take part in this discussion. The same rocks will form the subject of a paper by Mr. Walcot Gibson, of her Majesty's Geological Survey, who will deal with their rapid changes in thickness and character in the North Staffordshire coal field; and Mr. W. Cash, of Halifax, will also contribute a paper on the Lower Coal Measures of the West Riding. The fossil fishes of the local carboniferous rocks will be discussed in two papers by Dr. E. D. Wellburn, and the report of the committee for investigating life-zones in our carboniferous rocks will be presented by the secretary, Dr. Wheelton Hind. Another topic of general as well as of local interest which will receive the attention of the section is the underground water system in the carboniferous limestone districts of the West Riding. The Association last year made a grant of £40 to assist in the investigation of the underground course taken by streams which disappear into crevices of the limestone in the neighborhood of Ingleborough. By the free use of chemicals the committee appointed to carry out this investigation has traced the under-

ground course of some of these waters to their issue in springs at lower levels, with unexpected results, which throw much light on the general question of the percolation of waters through rock-fissures. The committee will present its report during the meeting, and excursions are being planned to visit the site of the experiments. As usual, glacial subjects will receive due attention, among the papers already promised being one on the glaciation of the Aire Valley by Messrs. H. Muff and A. Jowett, while others are expected on the glacial phenomena of Snowdon and on a similar subject in parts of the East Riding of Yorkshire. Three of the reports of committees of research will also afford scope for the discussion of glacial matters, viz: That on the erratic blocks of the British Isles, that on the conditions of occurrence of Irish elk-remains in the Isle of Man, and that on the Pleistocene deposits of Canada. The last mentioned, which is the final report of a committee appointed at the Toronto meeting of the Association, is likely to receive particular attention, as it embodies strong evidence in favor of the much-disputed occurrence of an inter-glacial period. It is expected that Professor A. P. Coleman, of Toronto University, who has been most active in the last mentioned committee, will attend in person to read the report. The same gentleman will also read a paper on the recent discovery of a ferriferous horizon in the Huronian rocks in Ontario, north of Lake Superior—a discovery which may eventually prove of great economic consequence. Cave-exploration in Ireland and at Uphill, near Weston-super-Mare, will be reported on by two committees of the Association. A further contribution to our knowledge of the geology of Anglesey will be made by Mr. E. Greenley, and Mr. Vaughan Cornish will bring forward the new results of his study of ripple-marks. In short, all the indications point to a profitable and enjoyable week for the geologists who visit Bradford.

Dr. R. H. Traquair will be president of Section D (Zoology), with which, on this occasion, Physiology will be combined. Dr. Traquair in his address, will deal with the 'Bearing of Fossil Ichthyology on the Doctrine of Descent.' Major Ronald Ross will contribute a paper on 'Malaria and Mosquitoes'; Messrs Gamble and Keeble on 'The Color Physiology of certain Marine Crustacea'; Professor L. C. Miall on 'The Respiration of Aquatic Insects.' In addition there will be, as usual, a number of communications of a more special character in all branches of natural history, together with the reports of various committees on the results of exploration and research.

Section E (Geography) will be presided over by Sir George Robertson, whose address will deal mainly with certain geographical aspects of the British Empire. He is likely to have much to say on the important element of distance and its diminution by means of improved communications. This Section is likely to be as attractive as usual. Sir Thomas Holdich will deal with the important subject of railway connection between Europe and Asia. Captain Deasy, Captain E. S. Grogan, and Mr. Borchgrevinck will repeat the story of their various expeditions in Asia, Africa and the Antarctic. Mr. E. G. Ravenstein and Mr. B. V. Darbishire are both to deal with the subject of colonial and foreign surveys. Mr. G. G. Chisholm has undertaken to deal with the important subject of the probable economic relations of Siberia and China. There will be one or two papers on the position of geographical teaching in Bradford and the neighborhood. Dr. H. R. Mill will deal with the geography of South-West Sussex, and Mr. E. Heawood with the commercial resources of Africa.

Section F (Economic Science and Statistics) will have as its president Major P.

G. Craigie, of the Department of Agriculture. In his address he will probably dwell on the care necessary for the properly scientific use of statistics and, above all, on the caution required in making international comparisons, illustrating his text, probably, with some of the better-proved figures which enable us to measure the development or retrogression of agriculture in different and typical countries. Doubtless owing to the fact of Major Craigie's being president, Section F this year will receive an unusual number of contributions relating to the economics of agriculture. Professor James W. Robertson, Dairy Commissioner of the Agricultural Department of the Dominion of Canada, and Professor William Saunders, LL.D., director of the Dominion experimental farms, will read papers, and Mr. A. D. Hall, of the Agricultural College of Wye, will deal with the economic possibilities of the growth of sugar beet in England, while a committee of the Section will at length present their report on the effect on prices of options and dealings in futures. There will be, as usual, a day devoted to what are roughly described as municipal subjects, and here Mr. Auberon Herbert is expected to condemn root and branch all attempts of local authorities to provide houses. Several interesting papers will be forthcoming on miscellaneous subjects. Mr. L. L. Price will deal with some economic consequences of the South African war, and the Hon. W. P. Reeves, Agent-General for New Zealand, will contribute a paper on the somewhat novel subject of 'The Colonies as Money-lenders.' Dr. Marcus Rubin, chief of the Royal Statistical Bureau of Denmark, will discuss some recent movements of population. There will also be several papers on questions of labor and wages. The historical school will be represented by Dr. W. Cunningham, who contributes a paper on North American paper currencies during the colonial period.

Sir Alexander Binnie will preside over Section G (Mechanical Science), and his address will take the form of an inquiry into the steps by which we have arrived at our modern conception of nature, when reviewed from a scientific standpoint. He will point out the reasons why the philosophers of Greece missed the true interpretation of nature, and, passing on to the Roman period and the dark ages, will show how there has gradually grown up the conception with which we are all so well acquainted and with which before us, when studying natural phenomena, the mind is freed from all preconceived notions derived from other realms of study. The address will be illustrated by a chronological chart likely to prove useful to all scientific men. It extends from 1550 to the present time, and includes, collated with the births and deaths of the many distinguished men to whom we are indebted, the principal historical, scientific, and other *data* which mark the various periods, as well as the dates of discoveries and of publications bearing upon the subject. There is, as usual, a large number of papers down for reading in this Section. We can only refer to the more important. The very fine waterworks belonging to Bradford will be described, on Thursday, by Mr. Watson, a local engineer. On Friday the papers will be mainly devoted to civil engineering. Professor Hele Shaw proposes to collect together, in his paper on 'Resistance on Roads,' all the known *data* on frictional resistance on common roads, and will, it is believed, strongly advocate the appointment of a committee of the Association to carry on some further experiments on rolling friction on common roads. The immediate value of the paper by Mr. J. H. Glass, on 'Proposed Railway Construction in China,' is likely to be lessened by the terrible events which have happened there since his paper was promised. His plan is to describe the

great trunk line which it was intended to construct in Southern and Central China, and to give some account of the immense mineral wealth which lies there almost undeveloped. The paper will be illustrated by many beautiful lantern slides reproduced from photographs. For Saturday there are down two papers, dealing with the great staple industry of Bradford and Yorkshire —textile manufacture. They will describe the more modern methods of mechanical and photo-mechanical designing for textile fabrics, and will be read by Professor Beaumont and Mr. Barker, who are both engaged locally in the technical teaching of textile work. Monday, as usual, will be given up to the electrical engineers. First on the program for the day comes the reading of the final report of the Small Screw Gauge Committee, which has now practically decided which form of thread it will advocate. Mr. A. Mallock will then deliver a paper paper on 'Resistance and Acceleration of Trains—Measurement of the Tractive Force,' in which he proposes to give an account of the recent experiments made by him on electric and other railways to determine the acceleration, the tractive force, and the running resistance to which trains are subjected. This will be followed by some interesting particulars about the 'Liverpool and Manchester Electric High Speed Railway,' contributed by Sir William Preece. Mr. Gibbings will deal with 'The Design and Location of Electric Generating Stations' on a large scale for supplying electric power and lighting to large districts, and Mr. Barker will describe 'A Maximum Demand Meter,' the joint invention of himself and Professor Ewing. Tuesday, the last day on which the section meets, will begin with a paper by Mr. J. G. W. Aldridge, entitled 'The Automobile for Electric Street Traction.' It is hoped that the cinematograph will be used—for the first time, it is believed, at a British Association meeting—to illustrate this paper, which will deal with an actual service in operation in Paris, and will show how, under certain conditions, a tramway service may be organized without the usual tramway lines. Professor Goodman will describe 'A New Form of Corimeter for measuring the Wetness of Steam,' which he has himself invented. Two other papers are of considerable importance. In the first, Professor Arnold of Sheffield, will deal with what he terms 'the internal architecture of steel,' and will develop his theories on the ultimate molecular structure of steel and the micrographic analysis of steel in physical researches. The second, by Mr. E. K. Clark, of the firm of Messrs. Kitson & Co., will deal, under the title of 'Shop Buildings,' with modern engineering, workshop buildings, and methods of laying them out and organizing the work in them.

Professor John Rhys, who will preside over Section H (Anthropology), will probably deal in his address with the early ethnology of the British Isles, approaching the subject from the sides of language and folklore. It is hoped that other contributions to this subject, which are anticipated, may give opportunities of discussing some of the vexed questions which it includes. A discussion is also proposed on the subject of 'Animal-cults: their Relation to Totemism,' which has been variously interpreted of late years; and on the present state of our knowledge of the origin of writing in the Mediterranean. Mr. Arthur Evans will describe the pictographic system of writing of which he has disinterred numerous specimens at Knossos in Crete; and Mr. F. Griffith offers a paper on the development of Egyptian hieroglyphics. Dr. Haddon will describe the results of the recent Cambridge expedition to Sarawak; and Mr. David Boyle, of Toronto, has a paper on recent revivals of native religious beliefs

among the aboriginal tribes of Canada. Professor Cunningham, Dr. Beddoe and Professor A. F. Dixon send papers dealing with questions of anthropometry.

Professor Sydney H. Vines will preside over the Botanical Section (J). His address will deal with Botany in the 19th century, and will be a review of the more important advances made in the different departments of the science. As has already been stated, this Section will have a joint discussion with the Geological Section on the Coal Period Vegetation. A museum is being arranged to illustrate the Yorkshire Coal Measure Flora, etc., in connection with the discussion. Mr. Percy Groom, of Coopers Hill Engineering College, is to deliver a semi-popular lecture before the Section entitled 'Plant-form in Relation to Nutrition.' There will also be papers on Fossil Plants, Plant Anatomy, Plant Physiology, etc.

The Friday evening discourse will be delivered by Professor Gotch, the subject being Animal Electricity, while that on Monday evening will be by Professor W. Stroud, whose subject will be 'Range Finders.' Professor Sylvanus P. Thompson will give the lecture to the operative classes on Saturday, and will take as his subject 'Electricity in the Industries.'

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*VARIATION AMONG HYDROMEDUSÆ.**

The announcement of Bateson in his 'Materials for the Study of Variation' that medusæ best illustrated the principle which he designated as 'Discontinuity of Meristic Variation' led me, in connection with researches which have been under way for several years, to note more specially any indications which might either confirm or discredit this statement. Accordingly I have from time to time made such collections of the Hydromedusæ as might afford a means of testing the matter. While as yet these have not been extensive, except in a few genera, they seem to be sufficient to warrant a brief summary of facts bearing upon the general problem of variation. The collections have been chiefly of the following genera: *Eucope*, *Obelia*, *Margelis*, *Pennaria* and *Gonionemus*.

The facts exhibited by *Eucope* have recently been published by Agassiz and Woodworth, and while I have made observations upon those which I had collected in larger numbers than any other, they are yet so similar to those made by these observers that I shall make no particular reference to them at this time. Of the species of *Obelia* and *Margelis* I have as yet had no opportunity for extended study. Facts presented here will have reference only to the species of *Pennaria* and *Gonionemus*.

Of *Pennaria* the medusæ are very small and of a shape which renders rather difficult an examination of the radial canals, a feature which, in my observations, has been among the most variable of structural characters. From the examination of only about a hundred specimens I have found no marked variation of this feature except in the direction of atrophy. The medusa of *Pennaria* seems to be in a somewhat degenerate condition. In many specimens the marginal canal is wholly atrophied and in some cases also the radials, to a greater or less extent. I have elsewhere* pointed out that in many cases the medusæ of this species never become free, but discharge the generative products while remaining connected with the polyp. Another feature which may prove to be a variation is the appearance of small wart-like or vesicular protuberances at various points of the exumbrella. Agassiz, in the North American *Acalephæ*, refers to a similar feature but explains it as probably due to the distortion caused by ova in the subumbrellar cavity. This, however, I am strongly convinced is

* Abstract of a paper presented before the Section of Zoology of the American Association.

* *Am. Nat.*, May, 1900.

a mistaken view, for the vesicles remain after the eggs have been discharged, and are quite as prominent in preserved specimens as in those alive and bearing eggs. As to variation in tentacles there seems to have been little. These organs are so rudimentary that detection of variations in them would be extremely difficult.

Upon the whole this species seems to be fairly constant in general structural features and only in the deeper and microscopic aspects are signs of degenerative variation specially apparent. The variation in physiological habits to which reference has been made are, however, very marked and of quite as much significance as are those more conspicuous morphological features usually cited. I would offer this suggestion that in those cases in which the medusæ perish early after discharging the ova, and specially those which do not become free at all, there may be some correlation between the atrophy of the chymiferous canals and this shortlived condition.

It is among the species of *Gonionemus* that I have discovered the most notable and numerous variations. Of these more than five hundred specimens were examined, all of which were taken at Woods Holl during the summers of 1897-99. Attention was directed chiefly to a study of the gonads, radial canals and tentacles. Of the specimens examined only fifteen showed abnormal or unusual genital features. In five specimens the gonads were atrophied upon one of the radial canals and equally developed upon the others. One specimen showed the gonads developed only upon one of the canals. Six specimens showed no trace whatever of gonads though they were of full size and normal in every other respect. Another specimen showed only traces of gonads as two small knobs near the bases of two approximate canals.

There was considerable variation in both the number and arrangement of tentacles. In reference to variation with age it was found that on the smallest specimen examined measuring two mm. in diameter the tentacles were twenty-nine, while on the largest 19 mm. in diameter there were 68 tentacles. The number, however, was not always proportional to the size. For example, one specimen of 4 mm. diameter had 39 tentacles, while another of 6 mm. had but 30; the largest referred to above had 68, while a specimen but 14 mm. in diameter had 71, and two others of 15 and 16 mm. had 72 each. In only 11 of the 500 specimens were the number of tentacles between each radical canal equal and symmetrical. In the order of appearance of new tentacles there did not seem to be any definite regularity. For example the following from many observations may reveal this more clearly:

(1) 2–1, 2–1, 2–1, etc. (2) 7–1, 3–1, 7–1, 3–1, etc. (3) 11–1, 11–1, 11–1, etc. In each case the 1 indicating the new tentacle.

In only a single specimen was there found any bifurcation of the tentacles which was so conspicuous a feature in *Eucope*. In this specimen there were two tentacles arising from a single sensory bulb and two others showed bifurcation, one near the tip, the other near the base.

In the number and character of the radial canals there was the most marked exhibition of variation. In number the variation was from two to six. Of the minimal number, two, only a single specimen was found, but it was in every way normal other than this, and the correlated fact that there were but two gonads. These canals were continuous and divided the body into halves.

Of specimens with six canals several were found, some of which clearly showed the canals converging symmetrically to the gastric pouch, but in a few cases the extra two canals were found to result from an

apparent bifurcation of two of the primary canals at distances varying from a fourth to three-fourths of the distance toward the margins.

Several specimens were likewise found with five canals. Indeed, this was a not uncommon feature and the medusa was divided into a regular pentamerous form, quite similar to reports made by several observers of pentamerous Aurelias.

Of those with three canals several varieties were found, those with three symmetrical canals dividing the bell into thirds, or making a trimerous form, the canals being at angles of 120 degrees. In other cases the one-half of the bell was equally divided by the third canal into quadrants while the other half remained undivided, showing that in this case there had been the total suppression of one of the canals.

In a few cases a sort of aboral circular canal was present, the radials instead of entering directly into the gastric pouch entered a circular canal which surrounded it. Of these there were several forms which only diagrams can make clear.

In conclusion it may be suggested that there was an apparent absence of any correlation of variation and also of any 'meristic' feature.

Charles W. Hargitt.
Syracuse University.

LATERAL LINE ORGANS IN EUNICE AURICULATA n. sp.

In a hitherto undescribed species of *Eunice*, to which I have given the above specific name, occurs a lateral line organ which, so far as I can learn, has not previously been discovered in this family. The specimens were collected in Porto Rico by the U. S. Fish Commission Steamer *Fish Hawk* during the winter of 1898–99.

The parapodium, as is characteristic of this genus, is uniramous, only the notopodium remaining, *not*, Fig. 1. Dorsally this carries a long cirrus *d. c.*, and a gill *gill* attached to this cirrus. These gills are absent from the most anterior segments and appear first on the parapodia of the 19th segment. The parapodium carries a single

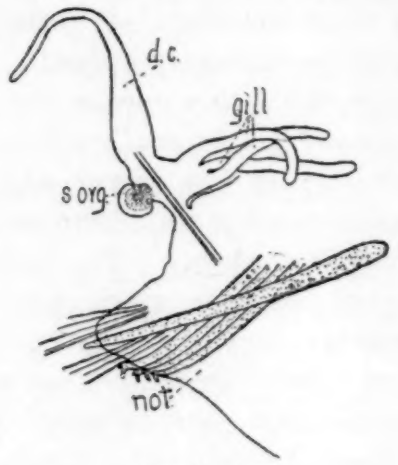

Fig. 1.

stout, straight, aciculum, with several smaller ones, toothed at the ends, and crossing the first at an angle. A dorsal and a ventral bundle of fine setæ are present. Anteriorly there is a thick ventral cirrus, which is much smaller toward the posterior end of the body (not shown in the figure.) A bundle of fine setæ extends into the dorsal cirrus.

The organ in question is situated on the outer side of the base of the dorsal cirrus, *s. org.*, Fig. 1. It appears on the first segment as a slight swelling, which becomes more

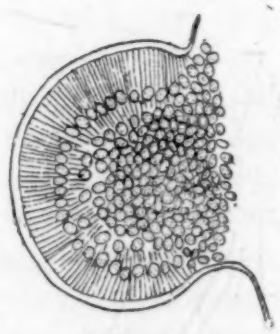

Fig. 2.

and more prominent posteriorly, until it reaches the condition shown in fig. 1. It is a rounded, smooth projection, slightly

constricted at the base, and in preserved material, showing no trace of pigment.

Examination of stained specimens shows that they apparently have the structure of the lateral line organs described by Eisig for the Capitellidæ.* There is the same arrangement of the nuclei, and the same radiations extending from the center toward the periphery (Fig. 2). No trace of cilia could be seen on preserved material, and the organ is apparently not capable of retraction into special sacks in the body wall. The cuticle, also, is relatively more thickened on the outside of the organ than is represented by Eisig's figures.

I am unable to give any details of the finer anatomy of these organs. The material at my disposal is not well enough preserved for histological study, and macerations and sections have thus far yielded no results. My only excuse for presenting this incomplete note is that while it is desirable that the existence of the organ in the group should be noted, there seems no probability of securing more favorable material.

AARON L. TREADWELL.
MARINE BIOLOGICAL LABORATORY,
WOODS HOLL, Aug. 10, 1900.

*'Fauna und Flora Golfes v. Neapel' 16, p. 76, *et seq.*

SCIENTIFIC BOOKS.

An Outline of the Theory of Thermodynamics. By EDGAR BUCKINGHAM, PH.D. (Leipzig), Associate Professor of Physics and Physical Chemistry in Bryn Mawr College. New York, The Macmillan Co.; London, Macmillan and Co., Limited. 1900. 14 x 22 cm. Pp. xi + 205.

In the preface of this newest book on thermodynamic theory, the author states his aim in the following words: "In the course of studying thermodynamics I have found a considerable gap between the text-books available and the modern memoirs. This volume has been written to spare other students some of the time which I have had to spend in bridging over the gap for myself. As the title indicates, it is not a book of applications, but a brief outline of the theory, the applications having been selected solely with a view to their illustrative value." The book is evidently intended for the beginning student.

The treatment begins with the necessary introductory concepts, then takes up successively the first and the second laws of thermodynamics, and concludes with a discussion of the criteria of thermodynamic equilibrium, and of the phase rule.

Under the first of these general heads appears a lucid and brief chapter on thermometry, an elaborate analysis of the idea of a quantity of heat, and the statement that only systems that have equations of equilibrium are to be considered. It is not emphasized, as it might well have been, that a quantity of heat is a purely auxiliary quantity, a convenient but wholly arbitrary mathematical fiction. In connection with the first law of thermodynamics, we find a simple discussion of the law, an exposition of the law of constant heat sums and of the relation between heat of reaction and temperature, and a study of specific heats. A recapitulation at this point completes the first half of the book.

Passing to the second law of thermodynamics, we are introduced to: reversible processes and Carnot's theorem; the ideas of absolute temperature and of entropy, derived from the properties of ideal gases; the combination of the two laws, to yield the differential of the energy of a system; and Gibbs's fundamental equations, which result from changing the independent variables. This part of the book is completed by an admirably clear and consistent account of the theory of the porous-plug experiment, and a number of simple illustrative applications of the general theory. The final three chapters are devoted mainly to the criteria of thermodynamic equilibrium, and to the phase rule as applied to systems in which no chemical combination occurs. It is not made clear here that the criteria of equilibrium are consequences of the inductively reached principle of the spontaneous dissipation of work availability.

In all this, Professor Buckingham has done pretty satisfactorily what he set out to do. The subject-matter is well arranged; the book is

brief, as it should be for the beginner; and the details of the treatment have been carefully thought out and clearly written. The result is probably as satisfactory a student's text as we have.

But a general comment in conclusion seems to be called for. Many people like to have their thermodynamics developed as a sort of sub-topic of the theory of ideal gases. They appear to think it suitable that one of the most beautiful and wide-reaching branches of physical theory should be developed largely from the properties of bodies that exist only in the imagination. In the reviewer's opinion, this procedure is neither necessary nor wise. There are two ways in which an exposition of theoretical thermodynamics can be written. One can reach the absolute temperature and the entropy from the properties of ideal gases, as Professor Buckingham has done; or he can arrive at these functions from fundamental physical postulates. The latter method reaches true results from true premises; while the former jumps to true results from untrue premises. The latter method, properly worked out, is fully as easy of comprehension as the former; and it gives a broader view: for it parallelizes the thermodynamic temperature with other potentials, and the entropy with other quantity-co-ordinates; and it brings out the distinction between forces and potentials, and between spaces and quantity-co-ordinates. As a plain matter of fact, the theory of thermodynamics of the present day is a symmetrical mathematical analysis of the general problem presented by a small number of inductively established postulates; and, in consequence, it cannot be grasped until it is comprehended as a logical system of mathematically developed theory.

J. E. Trevor.

Microörganisms and Fermentation. By Alfred Jorgensen. Third edition. Translated by Alex. K. Miller and A. E. Lennholz. The Macmillan Co. Pp. 318.

A practical knowledge of the phenomena of fermentation has been possessed by man from time immemorable. Until the present century, however, this knowledge has been purely an empirical one, the real cause of the phenomenon not being suspected. The present century has seen the development of the subject from a scientific standpoint, until to-day our knowledge of the process of fermentation is thoroughly systematic and based upon accurate experimentation. The development of our present knowledge upon the subject is properly divided into three periods. The first was that of the indefinite work of the early decades of the century, when Schwann and others were demonstrating that fermentative processes were closely related to the life activity of microörganisms. The second period was dominated by the revolutionary work of Pasteur. Under his influence not only was it demonstrated that fermentations were caused by microörganisms, but various types of fermentation were recognized and found to be produced by different species of microörganisms. Under Pasteur's influence the microscope came to be an aid to the fermentative industries and many a valuable practical method was suggested and applied to the fermentative processes. The third period has been the most fruitful in results and in many respects the most important. This period has been dominated by Hansen, of Copenhagen. So valuable has the work of Hansen been to the brewing industry that a large brewery of Copenhagen has erected for his use one of the best equipped laboratories in Europe, designed both for practical experiments and for pure scientific investigation. This third period of discovery has been dominated by the invention of methods of procuring *absolutely pure cultures* of yeasts.

There is no one better able to write an account of the relation of microörganisms to fermentation than the author of this work, who lives in close relation to Professor Hansen, and if his presentation of the subject is possibly unduly influenced by Hansen's work it is not to be wondered at. The fact is that the whole subject of fermentation has been entirely changed in the last two decades as a result of the study of the strictly pure cultures obtained by Hansen's methods. The earlier theories of fermentation have given place to the theory that fermentations are the results of enzymes produced by microörganisms. The knowledge of the yeast organism has been completely changed as the result of the study of pure cul-

tures. The few species known to Pasteur have become many and distinct in the hands of modern students. The diseases peculiar to fermentated products, attributed by Pasteur to bacteria, have been found to be frequently due to yeasts which are present as impurities, and the whole method of conducting fermentations in the great breweries has been modified in consequence. All these facts are brought out in more or less detail in this work of Jorgensen, who shows on every page of his writing a knowledge of the facts at first hand.

The whole work is not confined to the fermentations produced by yeasts. The growing knowledge of the significance of bacteria in fermentations has demanded attention, and the more important species of moulds are not overlooked. The treatment of this side of the subject is much less satisfactory than the study of yeasts. In his discussion of the butyric fermentation, the lactic fermentation and other strictly bacteriological phenomena Professor Jorgensen is evidently not so much at home as when he is writing of yeasts.

The most valuable part of the work is, therefore, the review of our present knowledge of yeasts. He describes the methods of studying air and water; the most recent methods of obtaining absolutely pure cultures of yeasts, the methods of cultivating them and experimenting with them. A considerable part of the work is taken up by a description and by figures of the many species of yeasts which have been differentiated from each other by modern study. Their methods of forming spores, of germinating, of forming films, and, in short, all of the characters of yeasts which are used today by the specialists in describing yeasts are carefully and fully discussed. As a morphological and physiological study of this extremely important group of plants the present work is complete and unequaled. Certainly there is no work in English that contains such a comprehensive account of the modern knowledge of yeasts and their relation to fermentation.

The name of The Macmillan Company on the title page is a sufficient guarantee of the excellence of the press work, as the name of the author is a guarantee for its scientific accuracy. It seems strange, however, that the author, the translators and the publishers should have allowed such a book to be published without an index. A book of this sort may perhaps be designed for consecutive reading, but it will be much more commonly used as a book of reference. As a book of reference its value would be doubled by the presence of a good index. No excuse can be given in these days of many books for omitting such an indispensable part as an index. The lack of the index is in part made up by a magnificent bibliography containing references to all the important works bearing directly or indirectly upon the problems of fermentation. This will be to the student perhaps the most useful part of the whole work.

H. W. C.

BOOKS RECEIVED.

Air, Water and Food from a Sanitary Standpoint. ELLEN H. RICHARDS and ALPHEUS G. WOODMAN. New York, John Wiley & Sons; London, Chapman and Hall, Limited. 1900. Pp. iv + 226. $2.00.

Prehistoric Implements. WARREN K. MOOREHEAD. Cincinnati, The Robert Clarke Co. 1900. Pp. xv + 429.

Die Chemie in täglichen Leben. LASSAR-COHN. Fourth edition. Hamburg and Leipzig, Leopold Voss. 1900. Pp. viii + 320. 4 Mark.

A Brief Course in General Physics, Experimental and Applied. GEORGE A. HOADLEY. New York, The American Book Company. 1900. Pp. 463. $1.20.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Physical Chemistry, April. 'A Preliminary Investigation of the Conditions which determine the Stability of Irreversible Hydrosols,' by W. B. Hardy; 'On the Mechanism of Gelation in Irreversible Systems,' by W. B. Hardy; 'Isohydric Solutions,' by W. D. Bancroft; 'Vapor-pressure Relations in Mixtures of Two Liquids,' by A. E. Taylor; 'In Reply to a Statement made by Dr. R. Cohen in a Paper on the Theory of the Transition Cell of the Third Kind,' by H. T. Barnes.

May. 'On the Weston Cell as a Transition Cell and as a Standard of Electromotive Force, with a Determination of the Ratio to the Clark Cell,' by H. T. Barnes; 'On the Electrolytic Deposition of Metals from Non-Aqueous Solu-

tions,' by Louis Kahlenberg—Faraday's law was found to hold approximately in such solutions; 'Vapor-pressure Relations in Mixtures of Two Liquids, II,' by A. E. Taylor; 'On the Determination of Transition Temperatures,' by H. M. Dawson and P. Williams; 'The Driving Tendency of Physico-Chemical Reaction, and its Temperature Coefficient,' by T. W. Richards.

June. 'The Allotropic Forms of Selenium,' by A. P. Saunders—an exhaustive contribution to an illy investigated subject. The author finds that selenium exists in three distinct forms:

1. Liquid (including vitreous, amorphous, and soluble selenium).

2. Crystalline red (including perhaps two closely allied forms).

3. Crystalline gray or metallic.

'An Exposition of the Entropy Theory,' by J. E. Trevor; 'Entropy and Heat-Capacity,' by J. E. Trevor; 'The Relation of the Taste of Acid Salts to their Degree of Dissociation, II,' by Louis Kahlenberg—showing that the theory of electrolytic dissociation does not satisfactorily account for the phenomena connected with the sour taste of acid salts of weak acids. A rejoinder to the work of T. W. Richards and of A. A. Noyes.

DISCUSSION AND CORRESPONDENCE.

EMINENT AMERICAN MEN OF SCIENCE.

To the Editor of Science: In Science of August 17th I notice the names of about twenty eminent Americans proposed as suitable to be engraved in the Hall of Fame of the New York University and also your question as to how many men of science should be included, and who they should be. In response to the query I beg respectfully to suggest the following names: Professor O. C. Marsh, Professor E. D. Cope, Dr. James Hall, Dr. D. G. Brinton, Professor J. D. Dana, Professor Newberry, Professor Orton, and Professor Alexander Winchell, in addition to those already mentioned. I do not see how these eight names could be omitted from such a list, nor do I see how the names of Henry, Silliman, Torrey, Gray, Hitchcock, and Baird could be left out. I should think that at least thirty men of science should be included among the one hundred.

Henry Montgomery.

Trinity University, Toronto,
August 20, 1900.

INTERNATIONAL COMMISSION ON ATOMIC WEIGHTS.

Science for August 17th contained a resumé of the report of the committee of the German Chemical Society, giving the views of the International Commission on Atomic Weights. On the chief point at issue, the selection of a standard for atomic weights, with the exception of six German members and one American (Professor Mallet), the commission was unanimous for oxygen = 16. This point, at least, would have seemed settled, but the German minority have in the last *Chemical News* reopened the question. The essence of their argument for H = 1 is comprised in the following paragraph:

"For the teacher, simplicity and clearness of the foundation seem specially important; instruction must suffer no harm with regard to the enlightening construction of the law of volumes, no shadow of doubt must penetrate the doctrine of valency. Regard for the understanding of prospective chemists will compel us therefore, under all circumstances, in teaching and in our text-books, to retain Dalton's numbers, and Professor F. W. Clarke, the worthy editor of the Annual Atomic Weight Tables of the American Chemical Society, authorizes us to say that he recommends the retaining of the standard H = 1. For if numbers were used in practice which were unsuitable to use in teaching, confusion would be the natural consequence, instead of the unanimity desired by all."

The German minority therefore calls upon all teachers of chemistry in universities and technical high schools to take a definite position in regard to this matter, and to send their answers to the subjoined questions to Professor J. Volhard, Halle-a-S., Mühlpforte 1, at their earliest convenience. The editor of the *Chemical News* also desires to publish copies of these replies. The questions are as follows:

1. Shall the unity of hydrogen be retained as the standard for reckoning atomic weights?

2. Shall the atomic weights be given approximately with two decimal places in which the

uncertain figures can be recognized by the type?

3. Shall the International Atomic Weight Commission have the current table of atomic weights edited on this basis?

In comment it may be mentioned that not all teachers are troubled by using O = 16 as a standard, and that there is a very large body of chemists outside the ranks of teachers, to whom this standard offers the decided advantage, that with this a large share of the more commonly used atomic weights approximate very closely to whole numbers. J. L. H.

PLANT EMBRYO-SACS.

SOME recent studies by the writer on the young ovules of the lily-of-the-valley, pond-weed (Potamogeton), and the garden canna have shown a number of interesting features in connection with the development of the embryo-sac. The first division of the nucleus in the hypodermal cell is heterotypic, while the next two represent the 'reducing division'; hence in these plants this cell strongly suggests the pollen-mother-cell of the anther. Apparent reduction takes place as usual just previous to the heterotypic division. The reduced number of chromosomes in the lily-of-the-valley was eighteen, in pond-weed about eight, while in canna it was only three, one of the smallest yet recorded for plants. In the lily-of-the-valley and pond-weed only the heterotypic division is followed by a cell wall, thus resulting in an 'axial row' of two binucleated cells; in canna all three divisions produce transverse walls and the axial row is therefore four celled. In the first named plant both cells enter into the formation of the embryo-sac, in pond-weed the lower only, while in canna only the lowermost of the row of four. Therefore in lily-of-the-valley the embryo-sac contains all four nuclear elements from the mother cell as in *Lilium*, in pond-weed only two, and in canna only one. Can the embryo-sacs in these cases be homologous structures, and should a macrospore contain more than one of these nuclear elements? In pond-weed a membraneous pouch formed around the egg-apparatus at a very early period seems to preclude entirely the fusion of polar nuclei to form the endosperm mother nucleus. In this plant also the chromatin is aggregated into a central ball during the resting stage as in some animal tissue. Those interested in the details of the work may find a fuller account in the *Botanical Gazette* for July of this year.

K. M. WIEGAND.

SCIENTIFIC NOTES AND NEWS.

THE monument of Lavoisier, erected by international subscription, was unveiled at Paris on July 27th. There were present the members of the fourth International Congress of Chemistry and a large number of scientific and public men. M. Berthelot who was to have presided was unable to be present on account of ill health, and his address was read by M. Darboux. The monument was presented to the city of Paris by M. Moissan, to whom M. Leygues, the minister of public instruction, responded.

FAIRMAN ROGERS, formerly professor of civil engineering in the University of Pennsylvania and one of the original members of the National Academy of Sciences, died in Vienna on August 21st. He was born in Philadelphia in 1833, graduated from the University of Pennsylvania and was professor of civil engineering in that institution from 1855 to 1870. From 1853 to 1865 he was also lecturer on mechanics in the Franklin Institute. On retiring from the professorship in the University of Pennsylvania he became a trustee, and gave later to the institution his valuable collection of works on engineering. Mr. Rogers served as an engineering officer in the civil war and was connected with the Coast and Geodetic Survey. He was the auther of 'The Magnetism of Iron Vessels' and of numerous papers on scientific and engineering topics. Mr. Rogers was formerly prominent in Philadelphia and New York society, but has latterly lived abroad.

THE Paris 'Conference Scientia' has given a banquet to Lord Lister and will later entertain in a similar manner Lord Kelvin.

M. DUHEM has been elected a correspondent of the Paris Academy for the section of mechanics.

DR. AUGUST LEPPLA has been appointed State geologist and Dr. Oskar Zeise district geologist in the Geological Institute at Berlin.

Dr. Karl Stöckl, of the University of Tübingen, has been appointed assistant in the Meteorological Institute at Munich.

Captain George Eldridge, a hydrographer, died on August 23d at Chatham, Mass., aged 72 years. He was the author of a book on the tides and completed valuable charts of the coast from Chesapeake Bay to Belle Isle. In later years he made charts of the waters along the coast as far south as Florida.

Sir William Stokes, the eminent Irish surgeon, died on August 19th at Durban, having gone to South Africa as consulting surgeon to the British forces. He was born in Dublin in 1839, being the son of Dr. William Stokes, regius professor of medicine in the University of Dublin.

The death is announced of Dr. August v. Strombeck, the geologist, in Braunschweig, at the age of 92 years.

A monument in honor of Pelletier and Caventou, the chemists, to whom the discovery of quinine is due, was unveiled at Paris on August 7th. An address was made by M. Moissan, president of the committee, who presented the monument of the city of Paris and by other speakers. There were a large number of pharmacologists present, as the dedication occurred at the time of the meeting of the Ninth International Congress of Pharmacology. The statue is by the sculptor, M. Lormier, and is on the Boulevard Saint Michel.

The Peabody Academy of Science at Salem, Mass., is trying to raise $50,000 for an addition to the Museum building. Already over $26,000 has been pledged for the purpose.

The New York Botanical Gardens at Bronx Park have received a valuable collection of plants from Miss Helen Gould.

More than 900 geologists have become members of the International Congress now meeting at Paris. It appears that four subjects will be brought forward for special discussion: international co-operation in geology, by Sir A. Geikie; the establishment of definite classifications, by T. C. Chamberlin; the publication of a petrographic lexicon by a committee on the subject, and the republication by photography of types of fossil species by Professors Œhrert and Kilian. Over 400 geologists will take part in the twenty-five excursions that have been arranged. A guide, 1000 pages in extent with numerous figures and plates, has been compiled by the leading French geologists.

Dr. W. H. Wiley has sent a notice to the effect that in harmony with the vote of the executive committee, the seventeenth annual meeting of the Association of Official Agricultural Chemists will be held in Washington, D. C., beginning Friday, November 16th, and continuing over Saturday and Monday, 17th and 19th, or until the business of the Association is completed. The authorities of Columbian University have extended the courtesy of the use of the University lecture hall for the various sessions. The following order of business will be observed: The president's address; reports of the referees in the following order: on nitrogen, on potash, on phosphoric acid, on soils, on ash, on foods and feeding stuffs, on liquor and food adulteration, on dairy products, on sugar, on tannin, on insecticides; reports of special committees (abstract committee, food standards, fertilizer legislation, volumetric standards).

A society with 400 members has been organized in Switzerland to study questions of school hygiene. Its first meeting has been held recently in Zurich under the presidency of Dr. Schmid, director of public hygiene. The next meeting will be at Lausanne.

The *Electrical World* reports that a conference in New Haven has been called by Mayor Cornelius T. Driscoll, and Director Alexander Troup, of the Department of Public Works, in order to devise means of saving the old elms of the city. The prolonged drought has accentuated the evidences of general decay, and the city government has at last awakened to the necessity of action. The State Agricultural Experiment Station has for several weeks been at work on the matter. An expert from there, Dr. A. B. Jenkins, will, at a general conference of citizens, to be held shortly, give the result of his observations. The officers of the street Electric Railroads, Electric Light Company and the Gas Distributing Company, have been invited as a body, and personal letters to leading

citizens have gone out from the mayor's office asking them to be present. Is it permanent pavements, or leakage from gas mains, or induction currents from the trolley wires, or the elm-tree beetle that killed the elms? these are the propositions to be discussed. In view of the fact that one-third of the elms on the Central Green are dead or dying, the matter is of great importance.

THE San José scale has appeared in Brooklyn in many places, and it is feared that the insects may do much damage to fruit and shade trees.

THE three surviving buffaloes of the Cheyenne River herd have been sent to Chicago, where they will be sold and perhaps slaughtered. It will be remembered that an attempt was made to continue the herd at Pierre, S. D., but without success.

THE government of Chile has assigned a sum of $20,000 to the president of the National Society of Agriculture to enable him to purchase agricultural machinery in foreign markets and sell it at cost price to members of the Society.

A REUTER telegram from Liverpool says: The second malarial expedition of the Liverpool School of Tropical Medicine has just wired home from Bonny, in Nigeria, news of a most important discovery, viz, that the parasite which causes elephantiasis has, like that which causes malaria, been found in the proboscis of the mosquito. Oddly enough, the same discovery has just been simultaneously made by Dr. Low in England in mosquitoes brought from Australia, and by Captain James in India. Elephantiasis is a disease which causes hideous deformity in thousands, or rather millions, of natives in tropical countries, and sometimes in European residents. It is due to a small worm which lives in the lymphatic vessels and occludes them. The fact that this worm can live also in the mosquito has long been known, but the discovery of it in the insect's proboscis shows that it enters the human body by the bites of these pests. Europeans in the tropics are indebted to mosquitoes not only for much discomfort but for two dreadful maladies—malaria and elephantiasis; and it is high time that the authorities should begin seriously to consider Major Ross's advice to destroy these insects or their breeding-places wherever practicable.

DURING the present summer Professor F. E. Nipher, of Washington University, has been working on his methods of developing positive photographs in the light. The work has been done in the rooms of Professor Calvin. He finds that as the camera exposure is made shorter, the developing band must be more strongly illuminated. He is now developing clear pictures, with no trace of fog when the bath is placed in the direct sunlight, but covered by transparent color screens. Good results have been obtained with ruby, and with pure yellow screens. The screens are made by fixing an unused photographic plate, and after drying the gelatin film, the plate is put in a water solution of red or yellow analine.

IT is said that the returns of the census indicate a population of the United States of about 75,000,000. The cities already counted show the following results, the returns for this year being placed beside those of 1890, with the percentage of increase:

Cities.	1900.	1890.	Percentage of increase.
Greater New York...	3,437,202	2,492,591	37.90
Chicago	1,698,575	1,099,850	54.44
Philadelphia	1,293,697	1,046,964	23.57
Cleveland.....	381,768	261,355	46.07
Buffalo	352,219	255,664	37.77
Cincinnati.....	325,902	296,908	9.77
Milwaukee.....	285,315	204,486	39.54
Washington.....	278,718	230,392	20.98
Jersey City.....	206,433	163,003	26.64
Louisville.....	204,731	161,129	27.06
Minneapolis.....	202,718	164,738	23.05
Providence.....	175,597	132,146	32.88
St. Paul.....	163,632	133,156	22.89
Toledo.....	131,822	81,434	61.88
Columbus.....	125,560	88,150	42.44
Omaha.....	102,555	140,425	—26.98
Hoboken	59,364	43,648	36.01

THE fifth part of Professor William H. Dall's important work on the *Tertiary Fauna of Florida*, forming the fifth part of Vol. III. of the Transactions of the Wagner Free Institute of Science, will probably appear in September.

MESSRS. HENRY HOLT & CO.'s preliminary fall announcement includes 'An Agricultural Botany' (theoretical and practical), by Professor

John Percival, of the Southeastern Agricultural College of Wye, England, intended for practical farmers who have made no systematic study of botany; 'The Anatomy of the Cat,' by Professor Jacob E. Reighard and Dr. Herbert S. Jennings, both of the University of Michigan; 'A Manual of the Flora of the Northern States and Canada,' by Professor N. L. Britton, director of the New York Botanical Garden; 'Schenck and Gürber's Human Physiology,' translated by W. D. Zoethout, with a preface by Professor Jaques Loeb, of the University of Chicago. The same publishers report that Professor James's 'Talks to Teachers on Psychology' has gone to press for the eighth time.

At the anniversary meeting of the Royal Botanic Society, London, the chairman, in moving the adoption of the 61st annual report of the council, referred to the death of the Duke of Teck, who had been president of the Society for more than 30 years. The presidency had since been offered by the council to the Duke of York, who had been obliged to decline. It has been offered to the present Duke of Teck, who is now in South Africa. The report stated that the number of new Fellows and members elected during the year had been 203, and there was now a total of 2205 fellows and members. The Royal Botanic Gardens Club had progressed in a very satisfactory manner, and the number of members was now 570. The School of Practical Gardening had been increased in number by the addition of ten more scholars from the London County Council Technical Education Board, and the Middlesex County Council had signified their intention of giving three scholarships. The Earl of Aberdeen and Viscount Curzon, M.P., were elected into the council.

The Annual Congress of the British Royal Institution of Public Health opened in Aberdeen on August 2d, with about 800 members in attendance. In the course of his presidential address, Lord Aberdeen reviewed the progress of sanitation, especially as represented by legislation upon the subject. He remarked, according to the report in the *London Times*, that it was exactly 100 years ago since the first enactments were passed which could be described as the direct ancestry of modern sanitary legislation. The earlier Factory Acts, designed especially for the protection of the children, who were often herded together promiscuously within the actual factory buildings, might come under this category. Another kind of legislation which advanced concurrently took its origin in the necessity which had to be faced in crowded communities for an organized supply of water as distinguished from independent and casual pumps and wells. So, too, with sewerage. The measures dealing with these elementary needs were the parents of our local sanitary Acts as distinguished from the factory class of legislation which had throughout been administered under the authority of the Home Office. It would be difficult to over-estimate the importance of the new kind of administration as a whole, not merely in regard to its direct remedial operations, but as to its indirect and suggestive influence in education and enlightenment as to health arrangements. There had been a great and growing advance in sanitation, but, reviewing the whole position, there was no cause for complacency. Contemplation of what had been accomplished, however, often in spite of prejudice and many obstacles, might assuredly give ground for encouragement and confidence as to future progress and attainment resulting from careful and persevering effort in dealing with the problems which still confronted sanitarians. Amongst these was overcrowding, and from every point of view—religious, moral, and humanitarian—there was crying need for the alleviation of that evil. Happily, public attention was being increasingly drawn to the subject, and a certain amount of reform had been attempted, but they must feel that the subject had yet to be grappled with in all its complexity and magnitude. Another field of sanitary reform was in relation to consumption, regarding which they seemed to have reached an epochal stage. That it was a subject for prevention and control was a revelation, and the main course of action would have to be that of educative regulation.

It is announced in the *British Medical Journal* that the Liverpool School of Tropical Medicine recently heard from the expedition it has sent to West Africa and America. Drs. Annett,

Elliott and Dutton report from Bonny that they have visited Opobo, Slave, Trees, Bakana, Bugana, Degama, Abonnema and Egwanga. They intended to revisit the latter place to complete some experiments there initiated, and then proceed up the Niger as far as Lokoja. The expedition under Drs. Durham and Myer received a cordial welcome from the authorities at Washington and Baltimore, and at the special wish of Dr. Sternberg, Surgeon-General of the United States Army, has gone to Cuba with the American government expedition to study yellow fever in Havana. The Brazilian government is preparing to receive the expedition at the end of this month. A letter has been received at the Liverpool School of Tropical Medicine from Dr. J. Paes de Cavalho, Governor of the State of Para, in reference to the expedition to study yellow fever. He writes: "Appreciating the high and scientific value of the Liverpool School I hereby anticipate my thanks for the valuable services that scientific institution will render to Para, to Brazil, and, in fact, to humanity, thus contributing to the study of a disease which, unfortunately, has become endemic in some Brazilian ports, and every year destroys hundreds of precious existences, carrying discredit to our country and harming our progress. To such a mission I most gladly pledge this government's assistance and co-operation, which I consider due to the noble intention of the said society. The State of Para will do its utmost to receive them with honor."

PROFESSOR E. RAY LANKESTER, director of the British Museum (Natural History), has addressed the following letter to the *Times:* Now that our army is guarding, for the most part peaceably, a line 1000 miles long from Cape Town to Pretoria, and that many of its members may be in want of occupation to fill their time, may I suggest that the opportunity might be taken to help our National Museum to obtain series of specimens illustrating the fauna and flora of the country? Even of the larger animals many of the commonest are still *desiderata* to our collections, while of the smaller things, from meerkats to mosquitoes, from squirrels and stoats to snakes and snails, there are none, however common locally, of which sets would not be of value and interest to our specific workers. It should be remembered that for the study of variation, individuals, seasonal and geographical, large series are wanted from as many different places as possible, so that no one, say, at Colesberg or De Aar, need think that his specimens will not be appreciated because some one else at Bloemfontein or Kroonstad is also sending specimens supposed to be of the same sort. Especially all the 'game' animals are wanted, from antelopes to smaller buck of different sorts (steenbok, grysbok, etc.), hares, rock rabbits, and other things that our officers appear to be now frequently shooting. Also such 'vermin' as jackals, hyenas, monkeys, baboons, etc. Skins and skulls of all these, marked with locality, date, and a clear indication of which skull belongs to which skin, would be most acceptable. And the same with the smaller animals. I shall be glad to hear from persons of natural history tastes in South Africa (and, indeed, in any other part of the world where our countrymen may be), and to give them fuller particulars about any special branch of natural history to which they may be attracted.

THE *Englishman*, of Calcutta, as quoted in the *British Medical Journal*, gives a summary of a resolution, extending over some 25 pages, which has been published in the Home Department on the chapters of the India Plague Commission dealing with the measures for the suppression of plague. Every aspect of the question is fully dealt with, and the main conclusions appear to be as follows: The government of India thinks the obligations of private persons and medical practitioners to report cases of sickness can be relied on only in very exceptional circumstances, and that the house-to-house visitations are justifiable only when plague exists in small well-defined areas. The government agrees with a surveillance over persons arriving from infected areas, and believes this means has been freely resorted to in rural areas, but does not favor the system of rewarding informers of plague cases. It publicly thanks the many volunteers who devoted themselves to the work of fighting the plague, and thinks the expense of special reporting

agencies are fully compensated for by their success. Much attention is devoted to the question of corpse inspection, but on a review of the whole case the government considers the compulsory examination of bodies a very unpopular measure and its object is likely to be defeated. With regard to the compulsory removal to hospitals the Governor-General accepts the conclusion of the Commission, but desires that the removal should be compulsory only in places and under circumstances when it can be an effectual precaution. The removal of moribund patients is prohibited. Government agrees that the segregation of contacts should be abandoned as ineffective and harassing, except where special conditions are stated by the Commission to enable it to be carried out. The complete evacuation of villages and small towns when attacked is believed to be the most effective safeguard against the spread of the disease yet discovered. The question of disinfection is dealt with at length, and Government considers the Commission's advice generally excellent. Government and the Commission are in accord with the precautions taken regarding the annual pilgrimage to the Hedjaz, but the examination of the passengers from one infected port to another is now ordered to cease. With regard to the examination of railway passengers, all local governments are desired to report on the question of reducing the inspection stations, as from an economical point of view it is highly desirable now to maintain only those which are absolutely necessary; and, acting on the advice of the Commission, all disinfection stations maintained on the railways are ordered to be closed.

Consul-General Guenther writes to the Department of State from Frankfort, July 24, 1900: According to the *Electro-Technical Gazette*, German electrical works show great increase. On March 1st last, there were in operation 652 electrical works, against 489 the previous year. One hundred and twenty-two works were in progress of construction, of which 17 were to be ready for operation on July 1st. Twenty-seven were completed before 1890; all the others were constructed within the last ten years. The number of places with electric light exceeds that of places illuminated by gas—900 against 850. The largest electrical plant is at Rheinfelden, with 12,360 kilowatts. Then follow one at Berlin, 9230 kilowatts; one at Hamburg, 7290 kilowatts; one at Munich, 6110 kilowatts; two others at Berlin of 5452 and 5312 kilowatts, respectively; one at Strassburg, 4955 kilowatts; two others at Berlin, of 4676 and 4655 kilowatts, respectively; one at Chorzon, 4310 kilowatts; one at Frankfort, 4152 kilowatts; one at Dresden, 3580 kilowatts; one at Stuttgart, 3208 kilowatts; and another at Hamburg, 3150 kilowatts. All the electrical works supplied last year 2,623,803 incandescent lamps, 50,700 arc lamps, 106,368 horsepower for electromotors, etc.

UNIVERSITY AND EDUCATIONAL NEWS.

In the will of James F. Malcolm, a bequest of $10,000 to Rutgers College, is revoked by a codicil in which he says that his daughter will carry out his intentions as expressed by him to her prior to his death.

The will of the late Collis P. Huntington gives $100,000 to Hampden Institute, Virginia. His house on Fifth Avenue, of great value, is left to Yale University, in case his son has no children.

The trustees of the Lowell Textile School have received a gift from Mr. Frederick F. Ayer of $35,000 for the purchase of a site for the school which has been in operation three years on leased property. The State, by the last Legislature, provided $35,000 for the erection of the buildings, on condition that land and machinery to like amount should be provided, so the whole sum of $70,000 is now available for the establishment of the school in a permanent home. There are now five important textile schools in the United States: Philadelphia, Lowell and New Bedford, Mass., Clemson, S. C., and Atlanta, Ga.

The Fayerweather will case has been once more reopened. It is said that the expenses of the suits have been about $500,000.

Professor Karl Auwers, of Heidelberg, has been appointed director of the Chemical Institute of Griefswald, as successor to Professor Limprecht, who has retired.